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Chronic Pain

Hope Through Research

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Cover: Treatment for this chronic headache sufferer at an NINDS-supported pain clinic in Seattle includes massage.

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Chronic Pain—
Hope Through Research

What was the worst pain you can remember? Was it the time you scratched the cornea of your eye? Was it a kidney stone? Childbirth? Rare is the person who has not experienced some beyond-belief episode of pain and misery. Mercifully, relief finally came. Your eye healed, the stone was passed, the baby born. In each of those cases pain flared up in response to a known cause. With treatment, or with the body's healing powers alone, you got better and the pain went away. Doctors call that kind of pain *acute* pain. It is a normal sensation triggered in the nervous system to alert you to possible injury and the need to take care of yourself.

Chronic pain is different. Chronic pain persists. Fiendishly, uselessly, pain signals keep firing in the nervous system for weeks, months, even years. There may have been an initial mishap—a sprained back, a serious infection—from which you've long since recovered. There may be an ongoing cause of pain—arthritis, cancer, ear infection. But some people suffer chronic pain in the absence of any past injury or evidence of body damage. Whatever the matter may be, chronic pain is real, unremitting, and demoralizing—the kind of pain New England poet Emily Dickinson had in mind when she wrote:

> *Pain—has an Element of Blank—*
> *It cannot recollect*
> *When it begun—or if there were*
> *A time when it was not*

The terrible triad

Pain of such proportions overwhelms all other symptoms and becomes *the* problem. People so afflicted often cannot work. Their appetite falls off. Physical activity of any kind is exhausting and may aggravate the pain. Soon the person becomes the victim of a vicious circle in which total preoccupation with pain leads to irritability and depression. The sufferer can't sleep at night and the next day's weariness compounds the

problem—leading to more irritability, depression, and pain. Specialists call that unhappy state the "terrible triad" of suffering, sleeplessness, and sadness, a calamity that is as hard on the family as it is on the victim. The urge to do something—anything—to stop the pain makes some patients drug dependent, drives others to undergo repeated operations or worse, resort to questionable practitioners who promise quick and permanent "cures."

"Chronic pain is the most costly health problem in America," says one of the world's authorities on pain. He and others estimate annual costs, including direct medical expenses, lost income, lost productivity, compensation payments and legal charges, at close to $50 billion. Here's how that adds up:

• *Headache.* At least 40 million Americans suffer chronic recurrent headaches and spend $4 billion a year on medications. Migraine sufferers alone account for 65 million workdays lost annually.

• *Low back pain.* Fifteen percent of the adult U.S. population have had persistent low back pain at some time in their lives. Five million Americans are partially

Traveling medicine shows were a standby in 19th century America featuring cures for whatever ailed you.

Federal agencies support research on pain.

disabled by back problems, and another 2 million are so severely disabled they cannot work. Low back pain accounts for 93 million workdays lost every year and costs over $5 billion in health care.

• *Cancer pain.* The majority of patients in intermediate or advanced stages of cancer suffer moderate to severe pain. More than 800,000 new cases of cancer are diagnosed each year in the U.S., and some 430,000 people die.

• *Arthritis pain.* The great crippler affects 20 million Americans and costs over $4 billion in lost income, productivity and health care.

Other pain disorders like the neuralgias and neuropathies that affect nerves throughout the body, pain due to damage to the central nervous system (the brain and spinal cord), as well as pain where no physical cause can be found—psychogenic pain—swell the total to that $50 billion figure.

Many chronic pain conditions affect older adults. Arthritis, cancer, angina—the chest-binding, breath-catching spasms of pain associated with coronary artery disease—commonly take their greatest toll among the middle-aged and elderly. Tic douloureux (trigeminal neuralgia) is a recurrent, stabbing facial pain that is rare among young adults. But ask any resident of housing for retired persons if there are any tic sufferers around and you are sure to hear of cases. So the fact that Americans are living longer contributes to a widespread and growing concern about pain.

Neuroscientists share that concern. At a time when people are living longer and painful conditions abound, the scientists who study the brain have made landmark discoveries that are leading to a better understanding of pain and more effective treatments.

In the forefront of pain research are scientists supported by the National Institute of Neurological Disorders and Stroke (NINDS), the leading Federal agency supporting research on pain. Other Federal agencies important in pain research include the National Institute of Mental Health (NIMH), the National Institute of Den-

tal Research (NIDR) and the National Cancer Institute (NCI). Within the last decade both the International Association for the Study of Pain and the American Pain Society have been established and grown into flourishing professional organizations attracting young as well as established research investigators and practicing physicians.

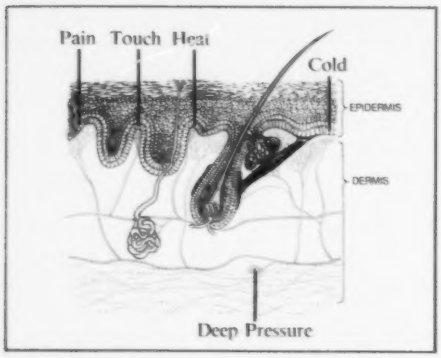
Sounding the pain alarm

Part of the inspiration for the new groups has come from a deeper understanding of pain made possible by advances in research techniques. Not long ago neuroscientists debated whether pain was a separate sense at all, supplied with its own nerve cells and brain centers like the senses of hearing or taste or touch. Maybe you hurt, the scientists reasoned, because nerve endings sensitive to touch are pressed very hard. To some extent, that is true: Some nerve fibers in your skin will be stimulated by a painful pinch as well as a gentle touch. But neuroscientists now know that there are many small nerve cells with extremely fine nerve fibers that are excited exclusively by intense, potentially harmful stimulation. Scientists call the nerve cells *nociceptors,* from the word noxious, meaning physically harmful or destructive.

Some nociceptors sound off to several kinds of painful stimulation—a hammer blow that hits your thumb instead of a nail; a drop of acid; a flaming match. Other nociceptors are more selective. They are excited by a pinprick but ignore painful heat or chemical stimulation. It's as though nature had sprinkled your skin and your insides with a variety of pain-sensitive cells, not only to report what kind of damage you're experiencing, but to make sure the message gets through on at least one channel.

Broadcasting the news

That same dispersion of forces continues once pain messages reach the central nervous system. Suppose you touch a hot stove. Some incoming pain signals are immediately routed to nerve cells that signal muscles to



Your skin is supplied with a variety of nerve endings sensitive to touch, pressure, heat, cold—and pain. The pain fibers are extremely fine in diameter, branching to form bare nerve endings.

contract, so you pull your hand back. That streamlined pathway is a reflex, one of many protective circuits wired into your nervous system at birth.

Meanwhile the message informing you that you've touched the stove travels along other pathways to higher centers in the brain. One path is an express route that reports the facts: where it hurts; how bad it is; whether the pain is sharp or burning. Other pain pathways plod along more slowly, the nerve fibers branching to make connections with many nerve cells (neurons) en route. Scientists think that these more meandering pathways act as warning systems alerting you of impending damage and in other ways filling out the pain picture. All the pathways combined contribute to the emotional impact of pain—whether you feel frightened, anxious, angry, annoyed. Experts called those feelings the "suffering" component of pain.

Still other branches of the pain news network are alerting another major division of the nervous system, the *autonomic nervous system*. That division handles the body's vital functions like breathing, blood flow, pulse rate, digestion, elimination. Pain can sound a

general alarm in that system, causing you to sweat or stop digesting your food, increasing your pulse rate and blood pressure, dilating the pupils of your eye, and signaling the release of hormones like epinephrine (adrenaline). Epinephrine aids and abets all those responses as well as triggering the release of sugar stored in the liver to provide an extra boost of energy in an emergency.

Censoring the news

Obviously not every source of pain creates a full-blown emergency with adrenaline-surging, sweat-pouring, pulse-racing responses. Moreover, observers are well aware of times and places when excruciating pain is ignored. Think of the quarterback's ability to finish a game oblivious of a torn ligament, or a fakir sitting on a bed of spikes. One of the foremost pioneers in pain research adds his personal tale, too, of the time he landed a salmon after a long and hearty struggle, only then to discover the deep blood-dripping gash on his leg.

Acknowledging such events, neuroscientists have long suspected that there are built-in nervous system mechanisms that can block pain messages.

Now it seems that just as there is more than one way to spread the news of pain, there is more than one way to censor the news. These control systems involve pathways that come down from the brain to prevent pain signals from getting through.

This fakir presents a striking example of internal pain control.

Investigators discover brain chemicals that control pain.

The gate theory of pain

Interestingly, a pair of Canadian and English investigators speculated that such pain-suppressing pathways must exist when they devised a new "gate theory of pain" in the midsixties. Their idea was that when pain signals first reach the nervous system they excite activity in a group of small neurons that form a kind of pain "pool." When the total activity of these neurons reaches a certain minimal level, a hypothetical "gate" opens up that allows the pain signals to be sent to higher brain centers. But nearby neurons in contact with the pain cells can suppress activity in the pain pool so that the gate stays closed. The gate-closing cells include large neurons that are stimulated by nonpainful touching or pressing of your skin. The gate could also be closed from above, by brain cells activating a descending pathway to block pain.

The theory explained such everyday behavior as scratching a scab, or rubbing a sprained ankle: the scratching and rubbing excite just those nerve cells sensitive to touch and pressure that can suppress the pain pool cells. The scientists conjectured that brain-based pain control systems were activated when people behaved heroically—ignoring pain to finish a football game, or to help a more severely wounded soldier on the battlefield.

The gate theory aroused both interest and controversy when it was first announced. Most importantly, it stimulated research to find the conjectured pathways and mechanisms. Pain studies got an added boost when investigators made the surprising discovery that the brain itself produces chemicals that can control pain.

The landmark discovery of the pain-suppressing chemicals came about because scientists in Aberdeen, Scotland, and at the Johns Hopkins University Hospital in Baltimore were curious about how morphine and other opium-derived painkillers, or analgesics, work.

For some time neuroscientists had known that chemicals were important in conducting nerve signals (small bursts of electric current) from cell to cell. In order for

the signal from one cell to reach the next in line, the first cell secretes a chemical "neurotransmitter" from the tip of a long fiber that extends from the cell body. The transmitter molecules cross the gap separating the two cells and attach to special receptor sites on the neighboring cell surface. Some neurotransmitters *excite* the second cell—allowing it to generate an electrical signal. Others *inhibit* the second cell—preventing it from generating a signal.

When investigators in Scotland and at Johns Hopkins injected morphine into experimental animals, they found that the morphine molecules fitted snugly into receptors on certain brain and spinal cord neurons. Why, the scientists wondered, should the human brain —the product of millions of years of evolution—come equipped with receptors for a man-made drug? Perhaps there were naturally occurring brain chemicals that behaved exactly like morphine.

The brain's own opiates

Both groups of scientists found not just one pain-suppressing chemical in the brain, but a whole family of such proteins. The Aberdeen investigators called the smaller members of the family *enkephalins* (meaning "in the head"). In time, the larger proteins were isolated and called *endorphins,* meaning the "morphine within." The term *endorphins* is now often used to describe the group as a whole.

The discovery of the endorphins lent weight to the general concept of the gate theory. Endorphins released from brain nerve cells might inhibit spinal cord pain cells through pathways descending from the brain to the spinal cord. Endorphins might also be activated when you rub or scratch your itching skin or aching joints. Laboratory experiments subsequently confirmed that painful stimulation led to the release of endorphins from nerve cells. Some of these chemicals then turned up in cerebrospinal fluid, the liquid that circulates in the spinal cord and brain. Laced with endorphins, the fluid could bring a soothing balm to quiet nerve cells.

Enkephalin fills the cell body and branches of this mouse spinal cord nerve cell grown in tissue culture by an NINDS scientist. The mouse cells are stained with a fluorescent dye that reacts with enkephalin.

A new look at pain treatments

Further evidence that endorphins figure importantly in pain control comes from a new look at some of the oldest and newest pain treatments. The new look frequently involves the use of a drug that prevents endorphins and morphine from working. Injections of this drug, naloxone, can result in a return of pain which had been relieved by morphine and certain other treatments. But, interestingly, some pain treatments are not affected by naloxone: Their success in controlling pain apparently does not depend on endorphins. Thus nature has provided us with more than one means of achieving pain relief.

• *Acupuncture.* Probably no therapy for pain has stirred more controversy in recent years than acupuncture, the 2,000-year-old Chinese technique of inserting fine needles under the skin at selected points in the body. The needles are agitated by the practitioner to produce pain relief which some individuals report lasts for hours, or even days. Does acupuncture really work? Opinion is divided. Many specialists agree that patients report benefit when the needles are placed near where it hurts, not at the body points indicated on traditional Chinese acupuncture charts. The case for acupuncture

has been made by investigators who argue that local needling of the skin excites endorphin systems of pain control. Wiring the needles to stimulate nerve endings electrically (electroacupuncture) also activates endorphin systems, they believe. Further, some experiments have shown that there are higher levels of endorphins in cerebrospinal fluid following acupuncture.

Those same investigators note that naloxone injections can block pain relief produced by acupuncture. Others have not been able to repeat those findings. Skeptics also cite long-term studies of chronic pain patients that showed no lasting benefit from acupuncture treatments. Current opinion is that more controlled trials are needed to define which pain conditions might be helped by acupuncture and which patients are most likely to benefit.

Acupuncture points are indicated in this Japanese version of traditional Chinese teaching.

Electrical stimulating techniques hold promise for relieving pain.

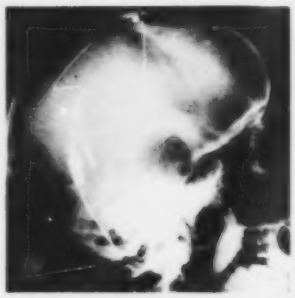
• *Local electrical stimulation.* Applying brief pulses of electricity to nerve endings under the skin, a procedure called transcutaneous electrical nerve stimulation (TENS), yields excellent pain relief in some chronic pain patients. The stimulation works best when applied to the skin near where the pain is felt and where other sensibilities like touch or pressure have not been damaged. Both the frequency and voltage of the electrical stimulation are important in obtaining pain relief.

• *Brain stimulation.* Another electrical method for controlling pain, especially the widespread and severe pain of advanced cancer, is through surgically implanted electrodes in the brain. The patient determines when and how much stimulation is needed by operating an external transmitter that beams electronic signals to a receiver under the skin that is connected to the electrodes. The brain sites where the electrodes are placed are areas known to be rich in opiate receptors and in endorphin-containing cells or fibers. Stimulation-produced analgesia (SPA) is a costly procedure that involves the risk of brain surgery. However, patients who have used this technique report that their pain "seems to melt away." The pain relief is also remarkably specific: The other senses remain intact, and there is no mental confusion or cloudiness as with opiate drugs. NINDS is currently supporting research on how SPA works and is also investigating problems of tolerance: Pain may return after repeated stimulation.

• *Placebo effects.* For years doctors have known that a harmless sugar pill or an injection of salt water can make many a patient feel better—even after major surgery. The placebo effect, as it has been called, has been thought to be due to suggestion, distraction, the patient's optimism that something is being done, or the desire to please the doctor (*placebo* means "I will please" in Latin).

Now experiments suggest that the placebo effect may be neurochemical, and that people who respond to a placebo for pain relief—a remarkably consistent 35 percent in any experiment using placebos—are able to tap

X-ray showing implanted electrodes for stimulating the cells that produce pain relievers. The patient controls the stimulation by operating an external transmitter.



Electrostimulator used by patient with chronic pain. The small electrical impulses stimulate the brain to produce naturally occurring pain-relieving substances.

into their brains' endorphin systems. To evaluate it, two NINDS- and NIDR-supported investigators at the University of California at San Francisco designed an ingenious experiment. They asked adults scheduled for wisdom teeth removal to volunteer in a pain experiment. Following surgery, some patients were given morphine, some naloxone, and some a placebo. As expected, about a third of those given the placebo reported pain relief. The investigators then gave these people naloxone. All reported a return of pain.

How people who benefit from placebos gain access to pain control systems in the brain is not known. Scientists cannot even predict whether someone who responds to a placebo in one situation will respond in another. The San Francisco investigators suspect that stress may be a factor. Patients who are very anxious or under stress are more likely to react to a placebo for pain than those who are more calm, cool, and collected. But dental surgery itself may be sufficiently stressful to trigger the release of endorphins—with or without the effects of placebo. For that reason, many specialists believe further studies are indicated to analyze the placebo effect.

As research continues to reveal the role of endorphins in the brain, neuroscientists have been able to draw more detailed brain maps of the areas and pathways important in pain perception and control. They have even found new members of the endorphin family: Dynorphin, the newest endorphin, is reported to be 10 times more potent a painkiller than morphine.

At the same time, clinical investigators have tested chronic pain patients and found that they often have lower-than-normal levels of endorphins in their spinal fluid. If you could just boost their stores with man-made endorphins, perhaps the problems of chronic pain patients could be solved.

Not so easy. Some endorphins are quickly broken down after release from nerve cells. Other endorphins are longer lasting, but there are problems in manufacturing the compounds in quantity and getting them into the right places in the brain or spinal cord. In a few promising studies, clinical investigators have injected an endorphin called beta-endorphin under the membranes surrounding the spinal cord. Patients reported excellent pain relief lasting for many hours. Morphine compounds injected in the same area are similarly effective in producing long-lasting pain relief.

But spinal cord injections or other techniques designed to raise the level of endorphins circulating in the brain require surgery and hospitalization. And even if

Research reveals the role of endorphins in the brain.

less drastic means of getting endorphins into the nervous system could be found, they are probably not the ideal answer to chronic pain. Endorphins are also involved in other nervous system activities such as controlling blood flow. Increasing the amount of endorphins might have undesirable effects on these other body activities. Endorphins also appear to share with morphine a potential for addiction or tolerance.

Meanwhile, chemists are synthesizing new analgesics and discovering painkilling virtues in drugs not normally prescribed for pain. Much of the drug research is aimed at developing nonnarcotic painkillers. The motivation for the research is not only to avoid introducing potentially addictive drugs on the market, but is based on the observation that narcotic drugs are simply not effective in treating a variety of chronic pain conditions. Developments in nondrug treatments are also progressing, ranging from new surgical techniques to physical and psychological therapies like exercise, hypnosis, and biofeedback.

New and old drugs for pain

When you complain of headache or low back pain and the doctor says take two aspirins every 4 hours and stay in bed, you may think your pain is being dismissed lightly. Not at all. Aspirin, one of the most universally used medications is an excellent painkiller. Scientists still cannot explain all the ways aspirin works, but they do know that it interferes with pain signals where they usually originate, at the nociceptive nerve endings outside the brain and spinal cord: peripheral nerves. Aspirin also inhibits the production of chemicals manufactured in the blood to promote blood clotting and wound healing: prostaglandins. Unfortunately, prostaglandins, released from cells at the site of injury, are pain-*causing* substances. They actually sensitize nerve endings, making them—and you—feel more pain Along with increasing the blood supply to the area, the chemicals contribute to inflammation—the pain, heat, redness and swelling of tissue damage.

The natural source of opiates is the opium poppy. While opiate drugs are potent painkillers, they are ineffective in treating some chronic pain disorders.

Some investigators now think that the continued release of pain-causing substances in chronic pain conditions may lead to long-term nervous system changes in some patients that make them hypersensitive to pain. People suffering such *hyperalgesia* can cry out in pain at the gentlest touch, or even when a soft breeze blows over the affected area. In addition to the prostaglandins, blister fluid and certain insect and snake venoms also contain pain-causing substances. Presumably these chemicals alert you to the need for care—a fine reaction in an emergency, but not in chronic pain.

There are several prescription drugs that usually can provide stronger pain relief than aspirin. These include the opiate-related compounds codeine, propoxyphene (Darvon®), morphine, and meperidine (Demerol®). All these drugs have some potential for abuse, and may have unpleasant and even harmful side effects. In combination with other medications or alcohol, some can be

dangerous. Used wisely, however, they are important recruits in the chemical fight against pain.

In the search for effective analgesics physicians have discovered pain-relieving benefits from drugs not normally prescribed for pain. Certain antidepressants as well as antiepileptic drugs are used to treat several particularly severe pain conditions, notably the pain of shingles and of facial neuralgias like tic douloureux.

Interestingly, pain patients who benefit from antidepressants report pain relief before any uplift in mood. Pain specialists think that the antidepressant works because it increases the supply of a naturally produced neurotransmitter, serotonin. (Doctors have long associated decreased amounts of serotonin with severe depression.) But now scientists have evidence that cells using serotonin are also an integral part of a pain-controlling pathway that starts with endorphin-rich nerve cells high up in the brain and ends with inhibition of pain-conducting nerve cells lower in the brain or spinal cord. Antidepressant drugs have been used successfully in treating the excruciating pain that can follow an attack of shingles.

Antiepileptic drugs have been used successfully in treating tic douloureux, the riveting attacks of facial pain that affect older adults. The rationale for the use of the antiepileptic drugs (principally carbamazepine—Tegretol®) does not involve the endorphin system. It is based on the theory that a healthy nervous system depends on a proper balance of incoming and outgoing nerve signals. Tic and other facial pains or neuralgias are thought to result from damage to facial nerves. That means that the normal flow of messages to and from the brain is disturbed. The nervous system may react by becoming hypersensitive: It may create its own powerful discharge of nerve signals, as though screaming to the outside world "Why aren't you contacting me?" Antiepileptic drugs—used to quiet the excessive brain discharges associated with epileptic seizures—quiet the distress signals associated with tic and may relieve pain that way.

Pain may have a psychological element.

Psychological methods

Psychological treatment for pain can range from psychoanalysis and other forms of psychotherapy to relaxation training, meditation, hypnosis, biofeedback, or behavior modification. The philosophy common to all these varied approaches is the belief that patients can do something on their own to control their pain. That something may mean changing attitudes, feelings, or behaviors associated with pain, or understanding how unconscious forces and past events have contributed to the present painful predicament.

• *Psychotherapy.* Freud was celebrated for demonstrating that for some individuals physical pain symbolizes real or imagined emotional hurts. He also noted that some individuals develop pain or paralysis as a form of self-punishment for what they consider to be past sins or bad behavior. Sometimes, too, pain may be a way of punishing others. This doesn't mean that the pain is any less real; it does mean that some pain patients may benefit from psychoanalysis or individual or group psychotherapy to gain insights into the meaning of their pain.

• *Relaxation and meditation therapies.* These forms of training enable people to relax tense muscles, reduce anxiety, and alter mental state. Both physical and mental tension can make any pain worse, and in conditions such as headache or back pain, tension may be at the root of the problem. Meditation, which aims at producing a state of relaxed but alert awareness, is sometimes combined with therapies that encourage people to think of pain as something remote and apart from them. The methods promote a sense of detachment so that the patient thinks of the pain as confined to a particular body part over which he or she has marvelous control. The approach may be particularly helpful when pain is associated with fear and dread, as in cancer.

• *Hypnosis.* No longer considered magic, hypnosis is a technique in which an individual's susceptibility to suggestion is heightened. Normal volunteers who prove to be excellent subjects for hypnosis often report a

marked reduction or obliteration of experimentally induced pain, such as that produced by a mild electric shock. The hypnotic state does not lower the volunteer's heart rate, respiration, or other autonomic responses. These physical reactions show the expected increases normally associated with painful stimulation.

The role of hypnosis in treating chronic pain patients is uncertain. Some studies have shown that 15 to 20 percent of hypnotizable patients with moderate to severe pain can achieve total relief with hypnosis. Other studies report that hypnosis reduces anxiety and depression. By lowering the burden of emotional suffering, pain may become more bearable.

• *Biofeedback.* Some individuals can learn voluntary control over certain body activities if they are provided with information about how the system is working—how fast their heart is beating, how tense are their head or neck muscles, how cold are their hands. The information is usually supplied through visual or auditory cues that code the body activity in some obvious way—a louder sound meaning an increase in muscle tension, for example. How people use this "biofeedback" to learn control is not understood, but some masters of the art report that imagery helps: They may

A pain clinic nurse prepares a patient for biofeedback treatment.

think of a warm tropical beach, for example, when they want to raise the temperature of their hands. Biofeedback may be a logical approach in pain conditions that involve tense muscles, like tension headache or low back pain. But results are mixed.

• *Behavior modification.* This psychological technique (sometimes called operant conditioning) is aimed at changing habits, behaviors, and attitudes that can develop in chronic pain patients. Some patients become dependent, anxious, and homebound—if not bedridden. For some, too, chronic pain may be a welcome friend, relieving them of the boredom of a dull job or the burden of family responsibilities. These psychological rewards—sometimes combined with financial gains from compensation payments or insurance—work against improvements in the patient's condition, and can encourage increased drug dependency, repeated surgery, and multiple doctor and clinic visits.

There is no question that the patient feels pain. The hope of behavior modification is that pain relief can be obtained from a program aimed at changing the individual's lifestyle. The program begins with a complete assessment of the painful condition and a thorough explanation of how the program works. It is essential to enlist the full cooperation of both the patient and family members. The treatment is aimed at reducing pain medication and increasing mobility and independence through a graduated program of exercise, diet, and other activities. The patient is rewarded for positive efforts with praise and attention. Rewards are withheld when the patient retreats into negative attitudes or demanding and dependent behavior.

How effective are any of these psychological treatments? Are some superior to others? Who is most likely to benefit? Do the benefits last? The answers are not yet in hand. Patient selection and patient cooperation are all-important. Analysis of individuals who have improved dramatically with one or another of these approaches is helping to pinpoint what factors are likely to lead to successful treatment.

Surgery should be carefully weighed.

Surgery to relieve pain

Surgery is often considered the court of last resort for pain: When all else fails, cut the nerve endings. Surgery can bring about instant, almost magical release from pain. But surgery may also destroy other sensations as well, or, inadvertently, become the source of new pain. Further, relief is not necessarily permanent. After 6 months or a year, pain may return.

For all those reasons, the decision for surgery must always involve a careful weighing of the patient's condition and the outlook for the future. If surgery can mean the difference between a pain-wracked existence ending in death, versus a pain-free time in which to compose one's life and see friends and family, then surgery is clearly a humane and compassionate choice.

There are a variety of operations to relieve pain. The most common is cordotomy: severing the nerve fibers on one or both sides of the spinal cord that travel the express routes to the brain. Cordotomy affects the sense of temperature as well as pain, since the fibers travel together in the express route.

Besides cordotomy, surgery within the brain or spinal cord to relieve pain includes severing connections at major junctions in pain pathways, such as at the places where pain fibers cross from one side of the cord to the other, or destroying parts of important relay stations in the brain like the thalamus, an egg-shaped cluster of nerve cells near the center of the brain.

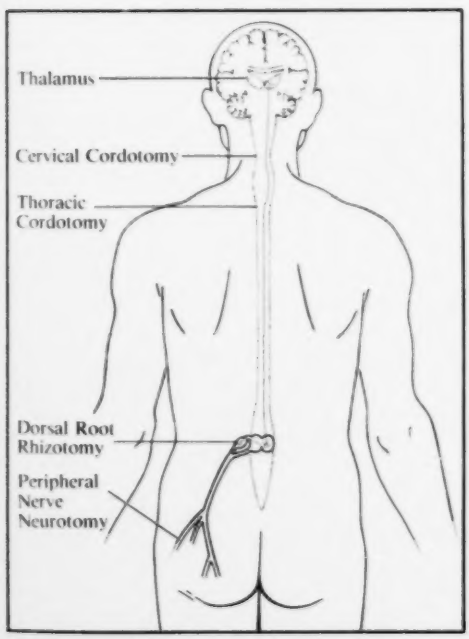
In addition, surgeons sometimes can relieve pain by destroying nerve fibers or their parent cell bodies outside the brain or spinal cord. A case in point is the destruction of sympathetic nerves (a part of the autonomic nervous system) to relieve the severe pain that sometimes follows a penetrating wound from a sharp instrument or bullet.

When pain affects the upper extremities, or is widespread, the surgeon has fewer options and surgery may not be as effective. Still, skilled neurosurgeons have achieved excellent results with upper spinal cord or brain surgery to treat severe intractable pain. These

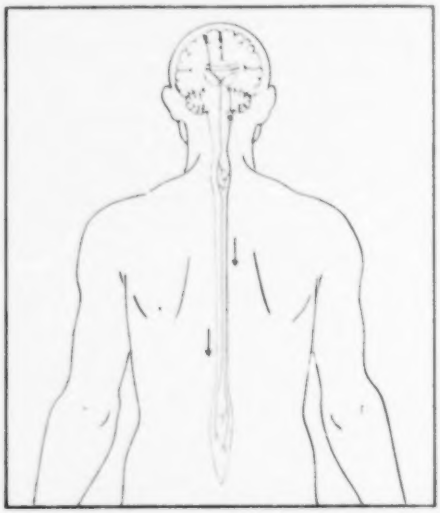
procedures may employ chemicals or use heat or freezing treatments to destroy tissue, as well as the more traditional use of the scalpel.

Recently, Harvard Medical School surgeons reported success with a new brain operation called cingulotomy to relieve intractable pain in patients with severe psychiatric problems. The nerve fibers destroyed are part of a pathway important in emotions and motivation. The surgery appears to eliminate the discomfort and suffering the patient feels, but does not interfere with other mental faculties such as thinking and memory.

Prior to operating, physicians can often test the effectiveness of surgery by using anesthetic drugs to block



This diagram shows sites along the spinal cord where nerve fibers can be severed to relieve pain.



This diagram shows nerve fibers descending from the brain to the spinal cord where they can inhibit pain in various areas.

nerves temporarily. In some chronic pain conditions—like the pain from a penetrating wound—these temporary blocks can in themselves be beneficial, promoting repair of nerve damage.

How do these current treatments apply to the more common chronic pain conditions? What follows is a brief survey of major pain disorders and the treatments most in use today.

The major pains

• *Headache.* Tension headache, involving continued contractions of head and neck muscles, is one of the most common forms of headache. The other common variety is the vascular headache involving changes in the pressure of blood vessels serving the head. Migraine headaches are of the vascular type, associated with throbbing pain on one side of the head. Genetic factors

Low back pain has many causes.

play a role in determining who will be a victim of migraine, but many other factors are important as well. A major difficulty in treating migraine headache is that changes occur throughout the course of the headache. Blood vessels may first constrict and then dilate. Changing levels of neurotransmitters have also been noted. While a number of drugs can relieve migraine pain, their usefulness often depends on when they are taken. Some are only effective if taken at the onset.

Drugs are also the most common treatment for tension headache, although attempts to use biofeedback to control muscle tension have had some success. Physical methods such as heat or cold applications often provide additional if only temporary relief.

• *Low back pain.* The combination of aspirin, bed rest, and modest amounts of a muscle relaxant are usually prescribed for the first time low back pain patient. At the initial examination, the physician will also note if the patient is overweight or works at an occupation such as truck-driving or a desk job that offers little opportunity for exercise. Some authorities believe that low back pain is particularly prevalent in Western society because of the combination of overweight, bad posture (made worse if there is added weight up front), and infrequent exercise. Not surprisingly, then, when the patient begins to feel better, the suggestion is made to take off pounds and take on physical exercise. In some cases, a full neurological examination may be necessary, including an x-ray of the spinal cord called a myelogram, to see if there may be a ruptured disc or other source of pressure on the cord or nerve roots.

Sometimes x-rays will show a disc problem which can be helped by surgery. But neither the myelogram nor disc surgery is foolproof. Milder analgesics (aspirin or stronger nonnarcotic medications) and electrical stimulation—using TENS or implanted brain electrodes—can be very effective. What is *not* effective is long-term use of the muscle-relaxant tranquilizers. Many specialists are convinced that chronic use of these drugs is detrimental to the back patient, adding to

depression and increasing pain. Massage or manipulative therapy are used by some clinicians but other than individual patient reports their usefulness is still undocumented.

• *Cancer pain.* The pain of cancer can result from the pressure of a growing tumor or the infiltration of tumor cells into other organs. Or the pain can come about as the result of radiation or chemotherapy. These treatments can cause fluid accumulation and swelling (edema), irritate or destroy healthy tissue causing pain and inflammation, and possibly sensitize nerve endings. Ideally, the treatment for cancer pain is to remove the cancerous tissue. When that is not possible, pain can be treated by any or all of the currently available therapies: electrical stimulation, psychological methods, surgery, and strong painkillers.

• *Arthritis pain.* Arthritis is a general descriptive term meaning an affliction of the joints. The two most common forms are *osteoarthritis* that typically affects the fingers and may spread to important weight-bearing joints in the spine or hips, and *rheumatoid arthritis*, an inflammatory joint disease associated with swelling, congestion, and thickening of the soft tissue around joints. Recently, a distinguished panel of pain experts commenting on arthritis reported that "in all probability aspirin remains the most widely used...and important drug...although it may cause serious side effects." In the 1950's the steroid drugs were introduced and hailed as lifesavers—important anti-inflammatory agents modeled after the body's own chemicals produced in the adrenal glands. But the long-term use of steroids has serious consequences, among them the lowering of resistance to infection, hemorrhaging, and facial puffiness—producing the so-called "moonface."

Besides aspirin, current treatments for arthritis include several nonsteroid anti-inflammatory drugs like indomethacin and ibuprofen. But these drugs, too, may have serious side effects. TENS and acupuncture have been tried with mixed results. In cases where tissue has been destroyed, surgery to replace a diseased joint with

an artificial part has been very successful. The "total hip replacement" operation is an example.

Arthritis is best treated early, say the experts. A modest program of drugs combined with exercise can do much to restore full function and forestall long-term degenerative changes. Exercise in warm water is especially good since the water is both relaxing and provides buoyancy that makes exercises easier to perform. Physical treatments with warm or cold compresses are helpful sources of temporary pain relief.

• *Neurogenic pain.* The most difficult pains to treat are those that result from damage to the peripheral nerves or to the central nervous system itself. We have mentioned tic douloureux and shingles as examples of extraordinarily searing pain, along with several drugs that can help. In addition, tic sufferers can benefit from surgery to destroy the nerve cells that supply pain-sensation fibers to the face. "Thermocoagulation"—which uses heat supplied by an electrical current to destroy nerve cells—has the advantage that pain fibers are more sensitive to the treatment resulting in less destruction of other sensations (touch and temperature).

Sometimes specialists treating tic find that certain blood vessels in the brain lie near the group of nerve cells supplying sensory fibers to the face, exerting pressure that causes pain. The surgical insertion of a small sponge between the blood vessels and the nerve cells can relieve the pressure and eliminate pain.

Among other notoriously painful neurogenic disorders is pain from an amputated or paralyzed limb—so called "phantom" pain—that affects up to 10 percent of amputees and paraplegia patients. Various combinations of antidepressants and weak narcotics like Darvon® are sometimes effective. Surgery, too, is occasionally successful. Many experts now think that the electrical stimulating techniques hold the greatest promise for relieving these pains.

• *Psychogenic pain.* Some cases of pain are not due to past disease or injury, nor is there any detectable sign

Over 800 pain clinics are now active in the United States.

of damage inside or outside the nervous system. Such pain may benefit from any of the psychological pain therapies listed earlier. It is also possible that some new methods used to diagnose pain may be useful. One method gaining in popularity is thermography, which measures the temperature of surface tissue as a reflection of blood flow. A color-coded "thermogram" of a person with a headache or other painful condition often shows an altered blood supply to the painful area, appearing as a darker or lighter shade than the surrounding areas or the corresponding part on the other side of the body. Thus an abnormal thermogram in a patient who complains of pain in the absence of any other evidence may provide a valuable clue that can lead to a diagnosis and treatment.

Where to go for help

People with chronic pain have usually seen a family doctor and several other specialists as well. Eventually they are referred to neurologists, orthopedists, or neurosurgeons. The patient/doctor relationship is extremely important in dealing with chronic pain. Both patients and family members should seek out knowledgeable specialists who neither dismiss nor indulge the patient; physicians who understand full well how pain has come to dominate the patient's life and the lives of everyone else in the family.

Many specialists today refer chronic pain patients to pain clinics for treatment. Over 800 such clinics have opened their doors in the United States since a world leader in pain therapy established a pain clinic at the University of Washington in Seattle in 1960.

Pain clinics differ in their approaches. Generally speaking, clinics employ a group of specialists who review each patient's medical history and conduct further tests when necessary. If the applicant is admitted, the clinic staff designs a personal treatment program that may include individual and group psychotherapy, exercise, diet, ice massage for pain (especially before bedtime), electrical stimulation techniques, and the use of a

variety of analgesic but nonnarcotic drugs. The aim is to reduce pain medication and so improve the patient's pain problem that when he or she leaves the hospital it is with the prospect of resuming more normal activities with a minimal requirement for analgesics and a positive self-image.

Contrary to what many people think, pain clinic patients are not malingerers or hypochondriacs. They are men and women of all ages, education, and social background, suffering a wide variety of painful conditions. Patients with low back pain are frequent, and so are people with the complications of diabetes, stroke, brain trauma, headache, arthritis, or any of the rarer pain conditions. The majority of patients participate for 2 or 3 weeks and usually report substantial improvement at discharge. One young man who had suffered painful chest injury as a result of a factory accident said he literally "felt taller" after his pain clinic experience. Followup at 3- and 6-month intervals, and at lengthier intervals thereafter, is an essential part of the program, both to evaluate the long-term effectiveness of treatment and to initiate a further course of treatment or counseling if necessary.

Ice massage is a useful supplement to other treatments for low back pain.

Pain clinics have the virtue that they bring together people with pain problems that have left them feeling isolated, helpless, and hopeless. But not everyone with a pain problem may need the support of a group or residence in a hospital. The important factors are that the pain patient—and the family—understand all the ramifications of pain, and the many and varied steps that can now be taken to undo what chronic pain has done. As a result of the strides neuroscience has made in tracking down pain in the brain—and in the mind—we can expect more and better treatments in the years to come. The days when patients were told "I'm sorry, but you'll have to learn to live with the pain" will be gone forever.

Voluntary health organizations

Several lay organizations are directly concerned with pain problems. They are excellent sources of additional information, research updates, and specific help and referrals:

American Chronic Pain Association, Inc.
257 Old Haymaker Road
Monroeville, PA 15146
(412) 856-9676

National Chronic Pain Outreach Association, Inc.
4922 Hampden Lane, Dept. P
Bethesda, MD 20814
(301) 652-4948

National Headache Foundation
5252 N. Western Avenue
Chicago, IL 60625
(312) 878-7715
(800) 843-2256 (Toll free)
(800) 523-8858 (Toll free in Illinois)

In addition, many organizations concerned with specific diseases, such as arthritis or heart disease, provide information and advice about attendant pain problems.

Pain clinics

While there is no official certifying agency accrediting pain clinics throughout the country, there are many excellent clinics, often affiliated with university-associated medical centers. Your family doctor or university medical center may be able to refer you to reputable clinics nearby. If not, physicians can write to the American Society of Anesthesiologists, 515 Busse Highway, Park Ridge, IL 60068, which publishes a worldwide pain clinic directory.

NINDS information

For additional information concerning NINDS research on pain write:

Office of Scientific and Health Reports
National Institute of Neurological Disorders and Stroke
Building 31, Room 8A06
National Institutes of Health
9000 Rockville Pike
Bethesda, MD 20892
(301) 496-5751

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